02 Extension Note

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Site Index Conversion Equations for Mixed Sitka Spruce / Western Hemlock Stands

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Abstract

Site index conversion equations relate the site indices of species growing in mixed stands. Linear equations are developed for mixed Sitka spruce / western hemlock stands. The site index of Sitka spruce is greater than that of western hemlock on sites with a spruce or hemlock site index greater than 20.

Introduction

Site index conversion equations relate the site index of one species to the site index of a cohort growing in a mixed stand. These equations are useful for site quality evaluation, growth and yield modelling, projecting inventories, and, in some cases, obtaining a site index for a stand after converting the species. The geometric mean regression (GMR) line (Ricker 1984) is appropriate for modelling the relationship between the site indices of species growing in mixed stands (Nigh 1995a), and GMR site index conversion equations for some species mixes are available (Nigh 1995b). This report describes new site index conversion equations for mixed Sitka spruce (*Picea sitchensis* (Bong.) Carr.) / western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) stands. This is a common and important species mix, particularly in the Queen Charlotte Islands of British Columbia. Site index conversion equations and the GMR line are covered only briefly in this report. If further details on these subjects are desired, the publications by Nigh (1995a, 1995b) should be consulted.

Data

Sixty-five 10.75 m radius plots were established in mixed Sitka spruce / western hemlock stands in the Queen Charlotte Islands. These stands were between 28 and 110 years breast height age. Three top height trees of both species were identified. Their heights were measured with a clinometer and their breast height ages were obtained by increment boring or sectioning the trees at breast height. Tree ring counts were done in the lab under magnification. Suppression was found in some of the top height trees; in these cases, substitute trees were utilized. Some sample trees were discarded if good ring (age) counts could not be obtained (usually because of broken and missing increment cores or because the pith was missed by an inestimable amount).

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Methods

The heights and ages of the sample trees were averaged by species within each plot. The site index of both species in each plot was then estimated from the average height and age (Wiley 1978; Barker and Goudie 1987). The parameters of the GMR line (Nigh 1995a), relating the site indices of the two species, were calculated. The residuals (errors in site index predictions) were calculated to test the model for bias. The heights of the species were compared to determine the type of stratification (Nigh 1995a).

Results

Table 1 presents the results of the analysis, and includes the mean and standard deviation of the site indices and the correlation between the site indices. The site index conversion equations for Sitka spruce and western hemlock are:

$$\hat{SI}_{Ss} = -4.94 + 1.25 \times SI_{Hw}$$

$$\hat{SI}_{Hw} = 3.96 + 0.801 \times SI_{Ss}$$

where:

SI_{Ss} = site index of Sitka spruce,
SI_{Hw} = site index of western hemlock, and
$\hat{}$ indicates that the site index is estimated.

The residual analysis shows that the models are unbiased. Figure 1 is a plot of the data points overlaid on the GMR line. In the Sitka spruce / western hemlock study plots, the spruce is usually taller than the hemlock, with the difference averaging around 2 m. The difference in height increases slightly as the height of the stand increases.

Discussion

The relationship between the site indices of the two species is linear and is modelled effectively by the GMR line. The high correlation between the site indices indicates that this relationship is strong.

On the poorer sites (site index less than approximately 20 m for either species), the site index of hemlock is higher than the site index of spruce. As the productivity of the site increases, the site index of Sitka spruce increases faster than that of hemlock; that is, the Sitka spruce grows at an increasingly faster rate than the hemlock. This could have some interesting management implications. For example, it may be preferable to regenerate poor sites with western hemlock and better sites with Sitka spruce. Further investigation into this phenomenon may be warranted, particularly with regards to the influence of ecosystem on the growth rate of the two species.

Western hemlock and Sitka spruce display consistent stratification (Nigh 1995a). Sitka spruce is consistently taller than the hemlock, although this difference is slight when the stand is below 20–25 m in height. Therefore, the conversion equations should only be applied to stands displaying consistent stratification.

TABLE 1 *Results of the GMR analysis*

Sitka Spruce		Western Hemlock		Correlation
Mean	Std. Dev.	Mean	Std. Dev.	Coefficient
30.274	6.9852	28.214	5.5963	0.93649

Conclusion

The GMR line models the relationship between Sitka spruce and western hemlock site indices when these species grow in mixed stands. The site index of western hemlock can be determined from the site index of Sitka spruce, or vice versa, with these models.

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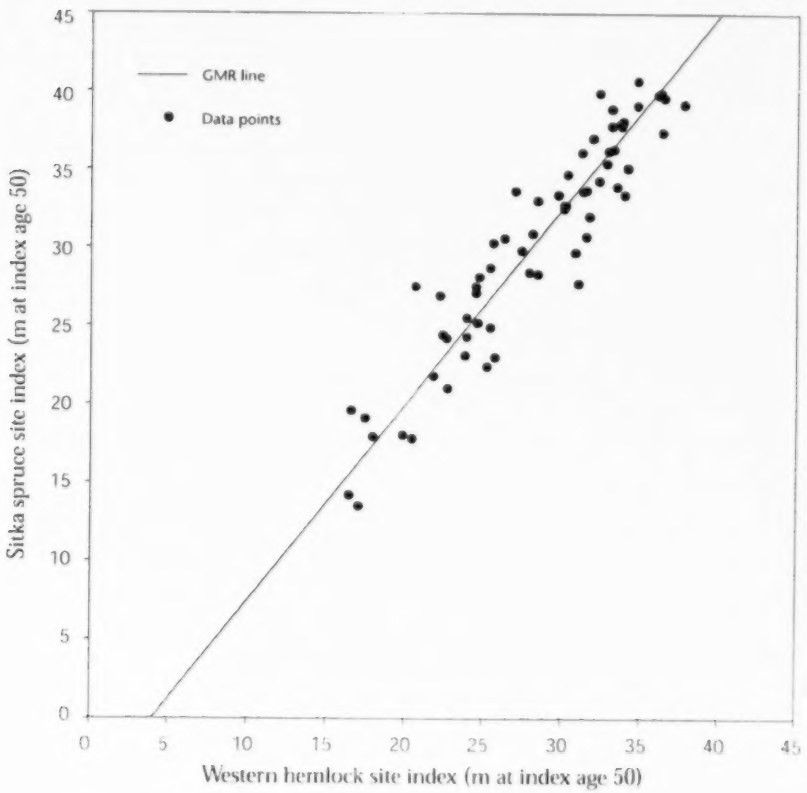

FIGURE 1 *Data points overlaid on the GMR line.*